The Cosmic Ray Telescope Hardware

The telescope HW is made of a main board that can manage up to four scintillator tiles (two tiles are required for minimum setup). Each tile contains a 10×10 square centimeters 0.6 cm thick scintillator (EJ200), a WLS fiber and a S13360-1350CS SiPM with dedicated amplifier. The main board provides the power supply for both tile amplifier and SiPM and includes the processing logic (analog and digital) for counting measurements. A block diagram of the system is shown in Figure 1.

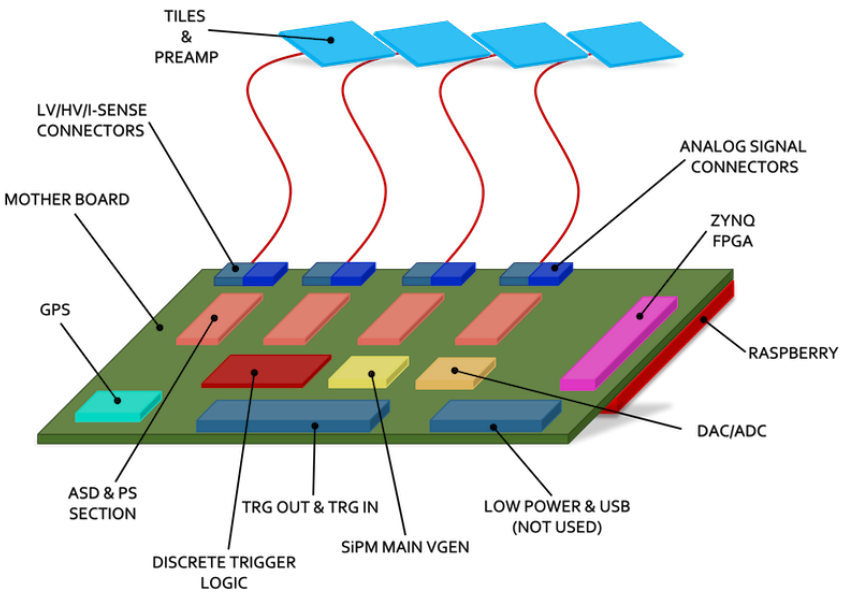

Figure 1: Cosmic Ray Telescope block diagram

The Cosmic Ray Telescope tile is shown in Figure 2; each tile contains:

- a 10×10 cm^2, 6.4 mm thick scintillator
- a WLS fibers
- a 1.3×1.3 mm^2 SiPM;
- a readout circuit (shown in Figure 3) with SiPM current sensing

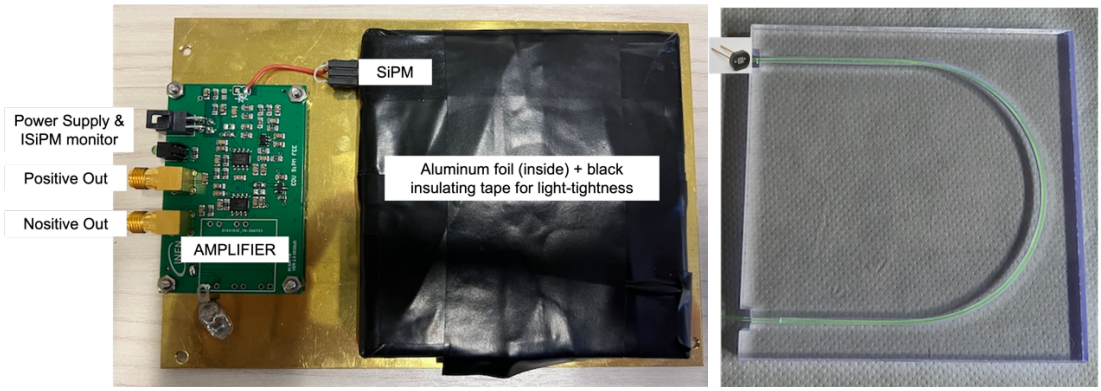

Figure 2: the Telescope Tail

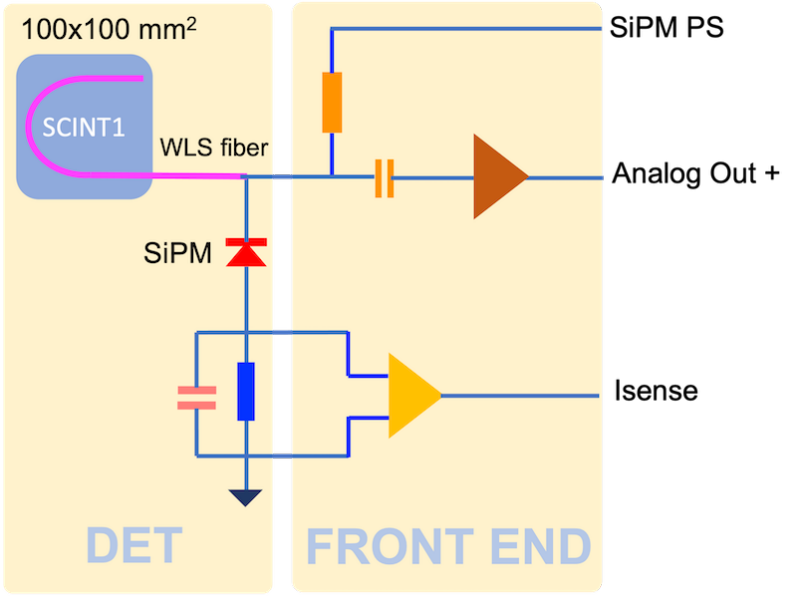

Figure 3: the amplifier block diagram

The Main Board is shown in Figure 4; the board is managed by a Raspberry Pi mini-computer and includes all components for SiPM voltage generation, signal discrimination, trigger generation and counting.

In detail it is possible:

- set four independent SiPM supply voltages
- set four independent threshold voltages
- monitor the SiPM power supply current
- set the trigger configuration

- count the trigger events
- accept an external trigger to increase the area in muon shower detection

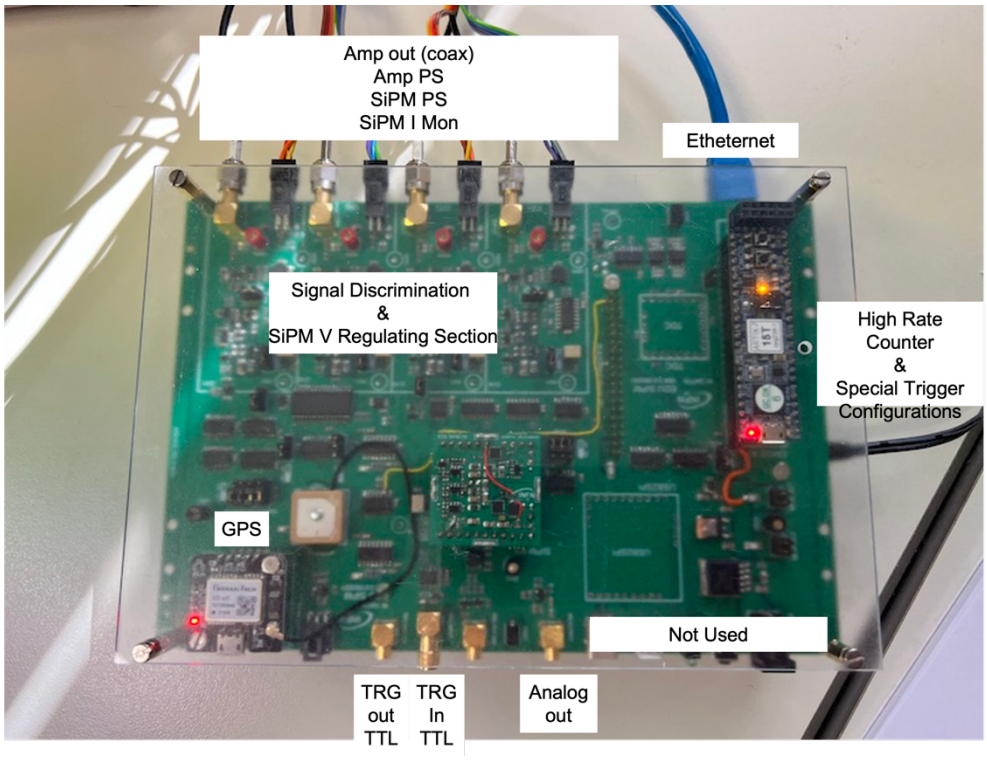

Figure 4: the Telescope Main Board

Because the system is managed by a Raspberry Pi board it can be managed via ethernet (wired or wireless) connection then allowing remote operation. Because the low requirement of supply current it can be managed by a standard battery pack then allowing outdoor cosmic ray measurements.